

A new method for interfacing unsuited subjects to overhead suspension partial gravity simulators

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The purpose of performing unsuited testing as part of a reduced gravity extravehicular (EVA) suited human performance research program is to define baseline performance. These results are then coupled with suited test results to evaluate how the suit system affects human performance at reduced gravity. The primary drawback to this approach is that previous studies used notably different systems to interface suited and unsuited subjects to overhead-suspension, partial-gravity simulators. A spreader bar (SB) assembly previously used for unsuited tests allowed limited pitch and roll of the subject, whereas the gimbal for suited tests allowed more pitch and roll, although the mass distribution led to large moments of inertia in the yaw axis. It is hypothesized that use of the same methods for offload of both unsuited and suited subjects is needed to make meaningful comparisons. A new gimbal (GIM) was designed with the idea that it could function with both suited and unsuited subjects. GIM was designed to minimize mass and moments of inertia and to be adjustable to co-locate the 3 axes of rotation with the subject's center of gravity. **OBJECTIVE:** To evaluate human performance differences between SB and GIM. **METHODS:** Ten unsuited subjects were offloaded to 1/6-g using both interfaces. Subjects completed tasks including overground and treadmill ambulation, picking up objects, shoveling, postural stability, range of motion testing, and recovery from the kneeling and prone positions. Metabolic, biomechanical, and/or subjective data were collected based on task. **RESULTS:** Initial analyses suggest that subjects completed all tasks with lower levels of compensation and a more terrestrial approach to movement when suspended via GIM. With SB, subjects were not able to fall or get into a prone position and had increased difficulty both retrieving objects off the floor and with overground ambulation, especially at gait initiation, because they were unable to bend their torso. GIM shows promise as a new method.